1409295

PATENT SPECIFICATION (11) 1409295

(21) Application No. 35507/72 (22) Filed 28 July 1972
(23) Complete Specification filed 10 April 1973
(44) Complete Specification published 8 Oct. 1975
(51) INT CL² B32B 5/20 3/30
(52) Index at acceptance
B2E 190 204 209 20Y 24Y 295 305 307 309 319 31Y
339 380 386 38X 38Y 416 41X 41Y 420 449 44Y
459 461 489 498 499 50Y 515 517 52Y 533 537
545 546 547 575 576 577 588 58Y 590 596 59X
59Y 620 626 62X 62Y 630 659 65Y 669 671 677
699 708 709 71Y 725 727 73Y 743 755 756 757
768 778 785 786 787 798 799 79Y 806
B5N 0330 0520 2730

(72) Inventor MICHAEL CHARLES AUSTIN

(54) SURFACE COVERING MATERIALS

(71) We, THE MARLEY TILE COMPANY LIMITED, a British Company of London Road, Sevenoaks, Kent, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the production of surface covering materials including for example, floor covering materials, wall covering materials and covering materials for shelves, working tops and the like.

Polyvinyl chloride surface covering materials are well-known the term "polyvinyl chloride" being used herein to include both vinyl chloride homopolymers and copolymers. Such surface covering materials can be produced in a variety of ways. For example sheets of polyvinyl chloride material can be formed using calendering equipment and then laminated together to provide surface covering materials of a desired thickness. In another method polyvinyl chloride plastisols are applied to a substrate such as asbestos paper or woven hessian fabric followed by gelation of the plastisol and if desired subsequent application of further polyvinyl chloride layers as necessary to provide surface covering materials of adequate thickness. If a film casting substrate is used as substrate, as described in our Patent No. 1,049,651, the substrate can be removed after gelation of the plastisol to provide a flooring material which does not incorporate a substrate. Alternatively layers of polyvinyl chloride material can be applied either side of the substrate, for example as described in our Patent No. 1,029,085. Also it is possible to manufacture a multi-layer polyvinyl chloride flooring material with one or more layers produced by calendering and another layer or other layers produced from polyvinyl chloride plastisol, for example as described in our Patent No. 1,206,584.

It is frequently desirable to provide polyvinyl chloride surface covering materials with a printed pattern for decorative purposes. The usual method of doing this involves printing the pattern on to the surface of the material using appropriate printing inks, e.g. by gravure printing. Having applied a printed pattern, it is usual to cover this with a transparent polyvinyl chloride wear layer; otherwise in use the pattern may quickly be removed by wear. Polyvinyl chloride wear layers can be applied for example either as preformed calendered sheets or using polyvinyl chloride plastisols.

For some purposes, particularly in the case of floor covering materials, it is desirable to incorporate foamed polyvinyl chloride material into the surface covering in order to provide a product with increased thickness which has resilience and good tread characteristics. It is thus known to produce floor covering materials including a foamed layer by incorporating heat-activatable blowing agents in layers of polyvinyl chloride material produced by calendering or by gelation of polyvinyl chloride plastisols and then to effect decomposition of the blowing agent and consequent foaming.

Where a foamed layer is included in surface covering materials, it has been found that materials of attractive appearance can be obtained by producing textured effects in the foam. The foamed layers are formed by applying a layer of a polyvinyl chloride composition containing a blowing agent on to a support and heating the composition to a temperature sufficient to decompose the blowing agent and thereby to effect foaming. One known method of producing a textured effect is to print a composition containing a foam inhibitor on to selected areas of the surface

[Price 33p]

of the foamable polyvinyl chloride composition prior to heating to effect foaming. Upon subsequent heating, foaming is inhibited in those areas where the foam inhibitor has been applied whilst foaming takes place in the usual way elsewhere. The composition containing the foam inhibitor can for example conveniently be applied by gravure printing and, where the composition used is a printing ink, it is possible to obtain textured effects in register with decorative printed patterns on the surface of the foamed layer. There has been a number of alternative proposals for the production of textured effects in surface covering materials including foamed layers, one such proposal being the method of our Patent No. 1,174,582. It is usual to protect the foamed layer with a transparent wear layer which can for example be applied on to the foamable polyvinyl chloride composition after application of foam inhibitor and printed decorative pattern but before heating to effect foaming.

It is an object of the present invention to provide a new process for the production of surface covering materials including resinous foam and having a textured effect.

According to one feature of the present invention there is provided a process for the production of surface covering materials having a textured effect which comprises (a) applying foamable resinous composition(s) containing a blowing agent and foamable throughout, in the form of a plastisol on to selected areas of a substrate, (b) applying at least one overall layer of an essentially non-foaming composition over the substrate and the foamable resinous composition(s) thereon, and (c) heating to effect foaming of the foamable resinous composition(s) whereby a surface covering material having a textured effect is produced; the said process including the provision of a decorative pattern by printing on to the surface of the overall layer(s) and/or by use of a pigmented substrate and/or pigmented foamable resinous composition(s) together with a transparent or translucent overall layer or overall layers. According to a further feature of the present invention, there is provided a surface covering material having a textured effect which comprises a substrate, foamed resinous composition(s) on selected areas of the substrate, at least one layer of an essentially non-foamed resinous composition over the substrate and the foamable resin composition(s) thereon; and a decorative pattern printed on the surface of the overall layer(s).

It is in general preferred to protect the decorative pattern printed on to the surface of the overall layer(s) by application of an additional transparent layer as a wear layer which is conveniently applied prior to the heating step to effect foaming.

The first step in the above process comprises applying foamable resinous composition(s) on to selected areas of a substrate. Suitable substrates include non-woven and woven fabrics and preformed films. In carrying out the process according to the invention, it is advantageous to select a substrate having good dimensional stability at the elevated temperatures encountered in subsequent steps of the process. Asbestos paper, a material in which asbestos fibres are bonded with synthetic rubber, is one substrate which can conveniently be used; others include woven glass fibre fabrics and glass fibres bonded, for example with synthetic resins. If desired, the substrate used may be impregnated with a resinous composition and/or may have one or more layers of resinous composition bonded either to the side on to which the foamable resinous composition is applied or to the reverse side thereof. Thus, for example, it may be convenient to apply a levelling coat of a resinous composition (which can be foamable or non-foamable) prior to application of the foamable resinous composition and/or to apply a layer of resinous composition (foamable) or non-foamable and if desired pigmented) on to either side of the substrate to increase the thickness of the final product to be obained. It will be appreciated that any such layers applied form part of the substrate in the sense that the term is used herein.

If desired, a film casting support (i.e. a support which is capable of supporting the foamable resinous composition in contact therewith and adhering thereto to enable the coating and subsequent heating operations to take place, the adhesion being such that the support can be readily removed from the product obtained after heating) may be used as substrate or a part thereof. Where a film casting support is used, it is preferably made of a paper, such as Kraft paper, treated to give the paper the required adhesive and release properties. Although the film casting support should have little adhesion to the resinous compositions applied thereto, it should exhibit sufficient adhesion to the resinous compositions whereby it is held in contact with the first applied resinous composition during the coating and heating processes. However, the adhesion of the film casting support to the first applied resinous composition should not be so strong as to prevent removal of the support from the product obtained after heating and for convenience the support should be capable of being removed cleanly and easily from the foamed product. Film casting paper can be given the required adhesive properties by coating the paper with, for example, silicone resin and polyvinyl compounds such as polyvinyl alcohol. Silicone resin coated paper is preferred and, by varying the quantity of silicone used in the coating, paper of the desired

adhesive properties may be prepared. Suitable film casting paper are commercially available, one such paper being that sold under reference M 4/17 by the Wiggins Teape Group.

The foamable resinous composition is advantageously applied on to selected areas of the substrate by the technique of rotary screen printing. In this method of printing, the foamable resinous composition is forced through a rotary metal cylindrical screen on to the material to be printed. The pattern is formed either by blanking off areas of the screen, e.g. using a cross-linkable lacquer, or alternatively by producing a screen which instead of an overall mesh has a mesh which itself is in the form of the desired pattern with other areas of the screen being without mesh holes.

The foamable resin composition used in the process according to the invention is preferably a polyvinyl chloride plastisol which contains a blowing agent and which has appropriate viscosity characteristics for rotary screen printing. The particular viscosity characteristics which are desirable are dependent upon a number of factors including the amount of plastisol to be applied per unit area of the substrate, the speed of printing and the means used for forcing the composition through the screen. With polyvinyl chloride plastisols, the plastisol will contain the polyvinyl chloride resin (selected according to the desired viscosity of the plastisol) plasticiser and stabiliser together wih blowing agent and optional ingredients such as for example fillers, viscosity modifiers, volatile additives and pigments.

The polyvinyl chloride included in the plastisol may be a homopolymer or copolyber, copolymers when used preferably containing a major proportion of units derived from vinyl chloride. Other copolymerised monomers which can be incorporated in the copolymers as desired include, for example, vinyl acetate and vinylidene chloride. The particle size of the polymer used is of importance in that the polymer particles must readily pass through the rotary screen used for printing. The particle shape may also be of importance in obtaining a plastisol composition having the most desirable viscosity characteristics for rotary screen printing; in general the particle shape should be selected to increase the pseudoplastic character of the plastisol. One polyvinyl chloride polymer which can with advantage be used in formulating plastisols for rotary screen printing is that known by the trade name "Breon P 130/1", the word "Breon" being a registered Trade Mark.

The plasticisers used in polyvinyl chloride plastisols for rotary screen printing are conveniently phthalate plasticisers, for example nonyl, octyl, butyl, butylbenzyl and dialphanyl phthalates. Phosphates (e.g. trixylenyl and tricresyl phosphates), adipates and sebacates may also for example be used as plasticisers.

It is in general necessary to incorporate into the plastisol a quantity of a stabiliser, that is a substance capable of retarding decomposition of the resin during compounding and subsequent exposure to light. Preferably the stabiliser selected is one which also possesses the property of causing the blowing agent to decompose over a narrower temperature range, hereinafter referred to as a "stabilizer-kicker". Dibasic lead phthalate is a suitable stabilizer-kicker and other substances which may be used include certain other lead-containing compounds, certain organo-tin compounds and certain metal soaps, particularly stearates of metals such as zinc, cadmium, barium and aluminium.

The blowing agent incorporated into the plastisol is in general preferably an organic substance which liberates nitrogen upon heating. Substances which are conveniently used as blowing agents are those which decompose over a relatively narrow temperature range. A particularly suitable blowing agent for use in the process according to the invention is azodicarbonamide.

Fillers may be incorporated into the plastisols as optional ingredients. Various inert inorganic substances may be used as fillers, the most convenient being calcium carbonate e.g. in the form of whiting, precipitated chalk, ground limestone or ground dolomite.

Viscosity modifiers may also be incorporated as required to influence the viscosity characteristics of the plastisol, hexylene glycol being an example of a viscosity modifier which can conveniently be used.

Volatile additives may also be included in the plastisols, examples of such additives being solvents such as, for example, white spirit and low boiling esters.

As stated above, the proportions of the various ingredients used must be selected to provide a plastisol having suitable viscosity characteristics for rotary screen printing. In general, preferred plastisols for use according to the present invention will contain, for every 100 parts by weight of polymer present, from 30 to 100 parts by weight of plasticiser; up to 5 parts by weight of stabiliser; up to 5 parts by weight of blowing agent; up to 100 parts, advantageously up to 20 parts, by weight of filler; up to 10 parts by weight of viscosity modifier; and up to 20 parts by weight of volatile additives.

In the final product, the foamable resinous composition is covered by at least one overall layer of resinous composition. Where the overall layer(s) subsequently to be applied

are opaque, the colour of the foamable resinous composition is of little importance and no pigment need be incorporated. If desired, it is however possible to utilise transparent overall layer(s) in which case the surface of the foamed resinous composition will be visible in the final product. Pigments of desired colour can then be incorporated into the foamable resinous composition, the type and proportion of pigment used depending upon the colour and shade desired. A suitable white pigment is titanium white. Suitable coloured pigments include inorganic pigments (e.g. iron oxide pigments and cadmium reds) and organic pigments (e.g. benzidene yellows and phthalocyanine blues and greens).

The foamable resinous compositions in the form of plastisols for rotary screen printing are conveniently printed using screens having a mesh size of from 17 to 100 British Standard Mesh, the use of a 40 British Standard Mesh having been found to be especially convenient. The thickness of the coatings of plastisol which are desirably applied depend upon the desired thickness and density of the foam in the final product. The thickness of plastisol which can conveniently be applied on to a substrate by the technique of rotary screen printing varies with the physical properties of the plastisol and also with the substrate itself, it being in general possible to print greater thicknesses of plastisol as quality print on to relatively absorbent substrates such as rubber bonded asbestos paper than on to relatively non-absorbent substrates such as preformed layers of polyvinyl chloride resin. In general it has been found that the thickness of foamable resin composition applied in one rotary screen printing step is conveniently not greater than 0.006 inches and is preferably not greater than about 0.004 inches. Thus the thickness of foamable resin composition applied are with advantage within the range of from 0.002 to 0.005 inches. If greater thicknesses over selected areas are desired, then these can readily be applied by using two or more rotary screen printing steps in series whereby two or more separate but registering applications of the foamable resinous composition are effected. The second and subsequent applications may, if desired, make use of foamable resinous compositions containing different amounts of blowing agents to achieve multi-level texturing on subsequent expansion. Also, the second and subsequent applications can, if desired, be only partly in register with the first application, again providing multi-level texturing on subsequent expansion.

If desired, a non-foamable resinous composition may also be applied on to selected areas of the substrate. Thus, for example, a non-foamable resinous composition can be applied on to selected areas of the substrate before the application of any foamable resinous composition and the foamable resinous composition can then be applied in register or partly in register with the non-foamable composition. In this embodiment, foamable composition in register with previously applied non-foamable composition will not be in direct contact with the substrate, but it will be appreciated that references herein to the application of foamable resinous composition on to selected areas of the substrate are intended to include cases where the substrate carries an intervening layer such as for example an intervening non-foamable or foamable layer. In an alternative embodiment, foamable resinous composition is first applied direct on to selected areas of the substrate and non-foamable resinous composition is then applied in register or partly in register with the foamable composition. If desired, successive applications of foamable composition, non-foamable composition and then foamable composition can be effected; likewise there can be successive applications of non-foamable composition, foamable composition and then non-foamable composition. As with the foamable composition, applications of non-foamable composition on to selected areas are advantageously effected by rotary screen printing using plastisols of the kind hereinbefore described but with the exclusion of a blowing agent.

After each application of a plastisol composition, it is in general convenient to dry the composition sufficiently to avoid undesired damage upon subsequent application of further coatings. Drying is conveniently effected by surface infra-red heating or hot air heating, for example at a temperature of about 140°C. It will be appreciated that the temperature and length of time used for drying is not critical provided that the coatings of resinous composition are given adequate strength for subsequent processing and also of course provided that the temperature reached during drying is not sufficient to activate the blowing agent contained in the foamable resinous composition. After heating, cooling is effected e.g. by contact with water-cooled rollers prior to the next step in the process. It is generally advantageous to dry the resinous composition to a matt finish, further drying whereby a glossy surface finish is obtained being preferably avoided.

The next step in the process according to the invention is the application of one or more overall layers of resinous composition. Whilst an overall layer can, if desired, be applied as a pre-formed film e.g. by calendering, it is in general preferred to form the layer by application of a polyvinyl chloride plastisol composition which is essentially non-foaming in character. The layer is conveniently applied by an overall spreading

technique, e.g. using a doctor blade or air-knife or rotary screen printing equipment with an all over mesh screen.

The polyvinyl chloride plastisol composition used in the production of the overall layer(s) is conveniently in the form of a spreadable paste. Suitable compositions are well-known and in general contain polymer (e.g. of the types described above with reference to the foamable plastisol), plasticiser also as described above) and optional ingredients such as fillers, viscosity modifiers and volatile additives (again as described above). The plastisols also conveniently contain stabilisers such as mixed barium, cadmium and/or zinc salts of fatty acids such as, for example, stearic, lauric and ricinoleic acids. Other known stabilisers include certain organo-tin compounds e.g. dibutyl tin dilaurate and lead-containing compounds such as dibasic lead carbonate and lead stearate. Auxiliary stabilisers such as epoxidised soya bean oil may also be incorporated as desired. The proportions of the various plastisol ingredients are preferably within the limits specified above in connection with the foamable plastisol excep that the amount of filler can, if desired, be increased above the limit of 100 parts per 100 parts of polyvinyl chloride.

The overall layer(s) of resinous composition can, if desired, be transparent or translucent (e.g. tinted), in which case pigmented foamable compositions and/or pigmented layers on the substrate can serve to provide decoration visible through the overall layer(s) in the final product. It is however in general preferable to use an opaque overall layer or layers the upper surface of which is visible as background colour in the final product. It will therefore in general be preferred to incorporate pigments into the resinous composition used for the overall layer(s), or when more than one overall layer is applied, used at least for the uppermost overall layer. Suitable pigments are those set forth hereinbefore in connection with the foamable composition.

The thickness of the overall layer(s) applied can vary within wide limits and will depend upon the desired thickness and texture, for the final product. If desired, the thickness can be the minimum thickness which is applicable without difficulty by the application method used to obtain a coherent layer. It has been found that the thickness of the overall layer is preferably at least 0.005 inches and when applied by rotary screen printing can, for example, conveniently be about 0.002 inches measured at points where the foamable resinous composition is applied. It will be appreciated that the thickness of the overall layer at points where the foamable resinous composition has not been applied will be greater particularly where the overall layer is applied by spreading. In general, the valleys between adjacent areas of foamable resinous composition will be detectable after application of the overall layer(s) although if the overall layer(s) are of sufficient thickness it is possible to obtain an essentially flat upper surface. In practice, however, particularly when a relatively thin overall layer is used, the valleys will still exist in the upper surface of the overall layer but will be significantly shallower in depth than before application of the overall layer. Whilst if desired, two or more overall layers can be applied, it is generally convenient to apply the desired thickness of overall layer in one process step.

Where the overall layer or layers are provided using plastisols as described above, after application of the overall layer (or each layer in the event that two or more overall layers are utilised), drying is again effected to provide a surface having sufficient strength for the subsequent printing process. The methods and temperatures conveniently used are as for the drying of the foamable resinous composition. The upper surface of the overall layer(s) is to be used as a recipient for the decorative pattern subsequently to be applied and, therefore it is again preferred to control the drying to obtain a matt surface finish.

After drying, the assembly is cooled prior to subsequent printing.

The next step in the process according to the invention is optional when transparent or translucent overall layers are used and involves the application by printing of a decorative pattern on to the surface of the overall layer(s). Roary screen printing or gravure printing is advantageously used for this step although other printing methods such as, for example, block printing can if desired be used. One particular advantage of rotary screen printing is that it is possible using this technique to print in the layers (corresponding to areas in which no foamable resinous composition has been applied) which, as explained above, will in general be present on the overall layer surface. Where relatively deep valleys are present and an ink which is not fully opaque is used, additional decorative effects may be obtained by printing the ink both in and out of register with the valleys. A more intense colouration will be obtained in the valleys due to the greater thickness of printing ink applied therein. Also the speed of rotary screen printing is compatible with the speed of the other process steps thus facilitating the carrying out of the process on a straight-through production line.

Where rotary screen printing is used, the printing compositions are preferably polyvinyl chloride plasticols of the kind hereinbefore described with reference to the application of the foamable resinous layer, with or without a blowing agent incorporated

although other printing compositions such as, for example, pigmented water-based acrylic resin emulsions can if desired be used. If printing compositions containing a blowing agent are used, then further texturing effects can be obtained in the final product. The plastisols can contain pigments as desired, suitable types of pigment being as hereinbefore described with reference to the formulation of the overall layer plastisol compositions. The decorative pattern applied can, if desired, be in register with textured effect to be provided by subsequent foaming of the foamable resinous compositions. Where differently coloured plastisols are to be applied to different portions of the overall layer surface, a plurality of rotary screen printing steps can be carried out in series with drying and cooling preferably to a matt finish between each step. In general the thickness of the coatings of printing composition applied can be varied within wide limits. Where it is desired to apply as thin coatings as possible, coatings of high opacity having a thickness of about 0.001 inches, can be used although even thinner coatings down to, for example, about 0.0002 inches may be sufficient particularly where multi-tone effects are desired. If thicker coatings are applied, relief effects can be obtained in the final product. The rotary screen printing is conveniently carried out using from 40 to 120 British Standard Mesh screens, a 60 British Standard Mesh screen being particularly convenient in this regard.

The decorative prints and the overall layer(s) to which they have been applied may have adequate wear characteristics without the protection of an overall transparent wear layer. In general, however, an additional overall transparent layer is preferably applied as a wear layer. As with the previous overall layer(s), this is conveniently provided by a polyvinyl chloride composition. Although a pre-formed calendered film can be used, it is preferred to apply the additional layer as a polyvinyl chloride plastisol, suitable formulations for providing a transparent wear layer being well-known. The thickness of the additional wear layer depends upon the wear characteristics required. In the case of flooring materials for domestic use, wear layers having a thickness of from 0.004 to 0.015 inces are conveniently used.

Next, heating is effected to gel the plastisols present in the assembly and to decompose the blowing agent present in the foamable resin composition(s). With polyvinyl chloride plastisols and the blowing agents commonly used therewith, temperatures within the range of from 165 to 200°C are in general preferably used. The ingredients of the foamable resin composition and the heating step are advantageously controlled to give approximately 2- to 5-fold expansion on foaming. Heating at about 180 to 190°C for about 100 seconds has given satisfactory results in processes according to the invention carried out under test conditions.

Where a film casting support is employed, this can be removed following the heating step and a permanent backing layer can then be applied. Thus, for example, a polyvinyl chloride backing layer can be applied either by adhesion of a preformed calendered film or by spreading of a polyvinyl chloride plastisol with subsequent galation.

The process according to the invention has been described above particularly with reference to surface covering materials produced using polyvinyl chloride resinous compositions. It will be appreciated however that other resinous compositions can be used if desired. Thus for example, acrylic based compositions can be used to provide coatings forming part of the substrate and polyurethane-based compositions can be used to provide flexible wear layers.

The accompanying drawings illustrate schematically two processes, according to the invention, showing cross-sections of surface covering materials at various stages of manufacture in accordance with the present invention.

Referring first to Figs. 1 to 5, 1 shows a substrate 1 selected areas of which have been coated with foamable resinous composition 2. In Fig. 2, the overall layer 3 has been applied over the substrate and the foamable resinous composition thereon. In Fig. 3, coatings 4 of printing composition have been applied in register with valleys between the foamable resinous composition and further coatings 5 of printing composition have been applied on to the overall layer 3 but not in register. In Fig. 4 an overall transparent wear layer 6 has been applied. In Fig. 5 the assembly has been heated to effect gelation and foaming of the foamable resinous composition 2 to provide the final product.

Referring to Figs. 6 to 11, Fig. 6 shows a substrate 1 selected areas of which have been coated with a foamable resinous composition 2. In Fig. 7 a second foamable resinous composition 2a has been applied partly in register, and partly out of register, with the composition 2. In Fig. 8, the overall layer 3 has been appplied over the substrate and the foamable resinous compositions thereon. In Fig. 9, coatings 4 of printing composition have been applied in register with valleys between the foamable resinous compositions and further coatings 5 of printing composition have been applied on to the overall layer 3 but not in register. In Fig. 10 an overall transparent layer 6 has been applied. In Fig. 11, the assembly has been heated to effect gelation and foaming of the foamable resinous compositions 2 and 2a to

produce a final product with a multi-level textured effect.

Apart from the steps hereinbefore described as providing the process according to the invention, it will be appreciated that additional process steps can be effected as desired. Thus for example, a resinous layer can be provided on the side of the substrate remote from the foamable resin composition at any stage in the course of the process, such layer being foamable or non-foamable as desired.

The process according to the invention is particularly useful for the preparation of flooring materials. Thus flooring materials can be prepared which have excellent wear properties, the transparent wear layer serving to protect the layers beneath, and an attractive appearance due to the combination of textured effect and decorative printing. Furthermore, the process according to the invention has particular advantages in that the transparent wear layer is separated from the foamed resinous composition by at least one intervening overall layer of an essentially non-foamable composition. Additional strength is imparted to the flooring in use by the reinforcing action of this overall layer and hence thicker foamable deposits may be utilised to increase the resilience of the flooring. The process also provides a wider field of choice for the polymer used in the wear layer. Certain polymers which are otherwise desirable for wear layers in that they provide good wear characteristics, lustre or other properties have the disadvantage that they are discoloured or otherwise adversely affected when used in wear layers in direct contact with foamed layers; such polymers can be used in the process according to the invention with an intervening non-foamed overall layer. Also the presence of the intervening overall layer generally avoids the danger of flaws being formed in the wear layer due to entrapment of gas released from the foamable resin composition(s) during foaming. A still further advantage is that when an opaque non-foamed overall resinous layer is used, it and not a foamed layer provides the background colour for the product, this being particularly advantageous where a white background is required as a more brilliant and desirable white is generally obtainable with non-foamable layers than with foamed layers. The process has the still further advantage of complete flexibility insofar as the decorative pattern to be applied is concerned. Once the overall layer(s) of resinous composition has/have been applied over the substrate and the foamable resinous composition thereon, the overall layer surface can be printed in any desired manner with printing composition applied on to any portion of the surface including valley portions.

Although the process is applied with particular advantage to the production of floor covering materials, it can be used for the production of other surface coverings, particularly wall and ceiling surface coverings.

The following Examples illustrate the invention:—

Example 1

A first polyvinyl chloride plastisol having the following composition is prepared:—

	Parts by weight
Polyvinyl chloride ("Breon P 130/1")	100
Dialphanyl phthalate	66
Hexylene glycol	3
Dibasic lead phthalate	2
Azodicarbonamide	1.25

The plastisol is printed on to selected areas of an asbestos paper substrate (0.032 inches thick) to a thickness of 0.006 inches using a rotary screen printer provided with a 40 British Standard Mesh screen. The coated substrate is then dried to a matt finish by infra-red heating at 140°C followed by cooling by contact with a water-cooled roll.

A second polyvinyl chloride plastisol having the following composition is next prepared:—

	Parts by weight
Polyvinyl chloride ("Breon P 130/1")	100
Dialphanyl phthalate	65
Coarse calmium carbonate filler	100
Barium cadmium liquid soap stabiliser	2.5
Epoxidised soya bean oil	3
Titanium white	10

This second plastisol which has the form of a spreadable paste is applied by doctor knife as an overall coating having a thickness of 0.004 inches measured at points where the first plastisol has been applied. Following application, the assembly is again dried to a matt finish by infra-red heating at 140°C followed by cooling by contact with a water-cooled roll.

Third and fourth polyvinyl chloride plastisols having the following composition are next prepared:—

	Parts by weight
Polyvinyl chloride ("Breon P 130/1")	100
Dialphanyl phthalate	65
Hexylene glycol	3
Barium cadmium liquid soap stabiliser	2.5
Epoxidised soya bean oil	3
Pigment	as necessary for desired colouring

The third plastisol composition is printed on to selected areas of the assembly to a depth of 0.002 inches using a rotary screen printer provided with a 60 British Standard Mesh screen. The coated substrate is then dried to a matt finish by infra-red heating at 140°C followed by cooling by contact with a water-cooled roll. The fourth plastisol composition is then printed on to further selected areas of the assembly to a depth of 0.002 inches with drying and cooling exactly as for the third plastisol composition.

A fifth polyvinyl chloride plastisol composition to provide the wear layer is then prepared having the following composition:—

	Parts by weight
Polyvinyl chloride (dispersion grade)	100
Dinonyl phthalate	15
Butylbenzyl phthalate	25
Hexylene glycol	3
Barium cadmium liquid soap stabiliser	2.5
Epoxidised soya bean oil	3.0
White spirit	3.0

This fifth plastisol having the form of a spreadable paste is applied by doctor knife as an overall coating having a thickness of 0.008 inches.

Following application, the assembly is heated in an oven to 180°C for 100 seconds to gel the plastisols and effect foaming of the first plastisol composition. Approximately 3- to 4-fold expansion is observed. Following the heating the assembly is cooled and rolled up to provide the finished product.

If desired, thinner layers of the third and fourth plastisol compositions, for example thicknesses of at little as 0.0005 inches, may be applied to selected areas of the assembly.

Example 2

A first polyvinyl chloride plastisol having the composition of the first polyvinyl chloride plastisol of Example 1 is prepared. The plastisol is printed on to selected areas of a film casting support (M4/17; Wiggins Teape Group) to a thickness of 0.004 inches using a rotary screen printer provided with a 40 British Standard Mesh screen. The coated substrate is then dried to a matt finish by infra-red heating at 140°C followed by cooling by contact with a water-cooled roll.

A second polyvinyl chloride plastisol having the composition of the second plastisol of Example 1 is next prepared in the form of a spreadable paste and is applied by doctor knife as an overall coating having a thickness of 0.007 inches measured at points where the first plastisol has been applied. Following application, the assembly is again dried to a matt finish by infra-red heating at 140°C followed by cooling by contact with a water-cooled roll.

Third and fourth polyvinyl chloride plastisols identical with the third and fourth plastisols of Example 1 are next prepared.

The third plastisol composition is printed on the selected areas of the assembly to a depth of 0.0005 inches using a rotary screen printer provided with a 60 British Standard Mesh screen. The coated substrate is then dried to a matt finish by infra-red heating at 140°C followed by cooling by contact with a water-cooled roll.

The fourth plastisol composition is then printed on to further selected areas of the assembly to a depth of 0.0005 inches with drying and cooling exactly as for the third plastisol composition.

A fifth polyvinyl chloride plastisol composition to provide a wear layer having a composition identical with the fifth plastisol of Example 1 is next applied by doctor knife as an overall coating having a thickness of 0.0008 inches.

Following application of the fifth plastisol composition, the assembly is heated in an oven at 180°C for 100 seconds to gel the plastisols and effect foaming of the first plastisol composition. Approximately 3- to 4-fold expansion is observed.

Following heating, the assembly is cooled and the film casting support removed.

A sixth polyvinyl chloride composition having the following composition is separately prepared:

	Parts by weight
Polyvinyl chloride ("Corvic D55/9", the word "Corvic" is a registered Trade Mark)	100
Ground limestone	100
Dialphanyl phthalate	50
White lead paste	5
Lead sterate	0.25

The sixth composition is formed into a backing layer of thickness 0.025 inches using a three roll calender at a temperature of 140°C.

The assembly is then laminated to the backing layer whilst still at 140°C by passing both layers through a laminating nip.

Alternatively the backing layer may be cooled and rolled and subsequently heated to a temperature sufficient to effect lamination with the assembly obtained after removal of the film casting support on passing both layers through a laminating nip.

As a third alternative the two layers may be joined together by the application of an adhesive to either or both layers prior to passing them through the laminating nip.

Example 3

A first polyvinyl chloride plastisol having the following composition is prepared: —

	Parts by weight
Polyvinyl chloride ("Breon P130/1")	100
Dialphanyl phthalate	66
Hexylene glycol	3
Dibasic lead phthalate	2
Azodicarbonamide	1.25

The plastisol is applied as an overall layer 0.010 inches thick to an asbestos paper substrate of thickness 0.032 inches using a doctor knife. The coated substrate is then dried to a matt finish by infra-red heating at 140°C followed by cooling by contact with a water-cooled roll.

A second polyvinyl chloride plastisol having the following compositions is next prepared:—

	Parts by weight
Polyvinyl chloride ("Breon P130/1")	100
Dialphanyl phthalate	66
Hexylene glycol	3
Dibasic lead phthalate	2.8
Azodicarbonamide	1.75

This second plastisol is printed on to selected areas of the first plastisol using a rotary screen printer provided with a 40 British Standard Mesh screen to give a thickness of second composition of 0.004 inches. The assembly is then again dried to a matt finish by infra-red heating at 140°C followed by cooling by contact with a water-cooled roll.

A third polyvinyl chloride plastisol having the following composition is next prepared:—

	Parts by weight
Polyvinyl chloride ("Breon P130/1")	100
Dialphanyl phthalate	65
Coarse calcium carbonate filler	100
Barium cadmium liquid soap stabiliser	2.5
Epoxidised soya bean oil	3
Titanium white	10

The third plastisol, which has the form of a spreadable paste, is applied by means of a rotary printer provided with a 40 British Standard Mesh screen to give an overall coating of thickness 0.002 inches measured at points where the second plastisol has been applied. Following application, the assembly is dried to a matt finish and cooled as previously described.

Fourth and fifth plastisol compositions identical with the third and fourth compositions of Example 2 are next prepared and applied to the assembly as described in Example 2. A wear layer composition is also prepared and applied as described in Example 2.

Finally, the assembly is heated in an oven at 180°C for 100 seconds to gel the plastisols and effect foaming of the first and second plastisol compositions. Following heating, the assembly is cooled and rolled up to provide the finished product.

WHAT WE CLAIM IS:—

1. A process for the production of surface covering materials having a textured effect which comprises (a) applying foamable resinous composition(s) containing a blowing agent and foamable throughout, in the form of a plastisol, on to selected areas of a substrate, (b) applying at least one overall layer of an essentially non-foaming composition over the substrate and the foamable resinous composition(s) thereon, and (c) heating to effect foaming of the foamable resinous composition(s) whereby a surface covering material having a textured effect is produced; the said process including the provision of a decorative pattern by printing on to the surface of the overall layer(s) and/or by use of a pigmented substrate and/or pigmented foamable resinous composition(s) together with a transparent or translucent overall layer or overall layers.

2. A process as claimed in claim 1 wherein the substrate comprises a non-woven or woven fabric or a preformed film.

3. A process as claimed in claim 2 wherein the substrate comprises a rubber-bonded asbestos paper.

4. A process as claimed in any of the preceding claims wherein subsequent to step (b) and prior to step (c) a decorative pattern is printed on to the surface of the overall layer(s).

5. A process as claimed in claim 4 wherein the uppermost overall layer is pigmented.

6. A process as claimed in any of the preceding claims wherein the substrate comprises a film casting support (as herein defined).

7. A process as claimed in claim 6 wherein subsequent to step (c), the film casting support is removed.

8. A process as claimed in claim 7 wherein subsequent to removal of the film casting support a backing material is applied to the product.

9. A process as claimed in claim 8 wherein the backing material comprises a polyvinyl chloride composition.

10. A process as claimed in any of the preceding claims wherein prior to step (a) an overall coating of a foamable resinous com-

position is applied on to a support material to provide the said substrate.

11. A process as claimed in any of claims 1 to 3 and 6 to 10 wherein the overall layer(s) is/are transparent or translucent and the substrate and/or foamable composition(s) is/are pigmented.

12. A process as claimed in claim 4 or 5 wherein the foamable resinous composition(s) is/are polyvinyl chloride plastisol(s) containing a blowing agent.

13. A process as claimed in claim 12 wherein the said plastisol(s) contain(s), for every 100 parts by weight of polymer, from 30 to 100 parts by weight of a plasticiser, up to 5 parts by weight of a stabilizer, up to 5 parts by weight of blowing agent, up to 20 parts by weight of a filler, up to 10 parts by weight of a viscosity modifier and up to 20 parts by weight of volatile additives.

14. A process as claimed in any of the preceding claims wherein the blowing agent is azodicarbonamide.

15. A process as claimed in any of the preceding claims wherein, in step (a) the foamable resinous composition(s) is/are applied by rotary screen printing.

16. A process as claimed in any of claims 4, 5 and 12 to 15 wherein in step (b) the overall layer of resinous position is provided by an essentially non-foamable polyvinyl chloride plastisol.

17. A process as claimed in claim 16 wherein the said plastisol contains, for every 100 parts by weight of polymer, from 30 to 100 parts by weight of a plasticiser, up to 5 parts by weight of a stabilizer, up to 100 parts by weight of a filler, up to 10 parts by weight of a viscosity modifier and up to 20 parts by weight of volatile additives.

18. A process as claimed in any of claims 4, 5 and 12 to 17 wherein the decorative pattern is applied by printing a pigment-containing polyvinyl chloride plastisol on to the overall layer applied in step (b) in register with the areas of foamable resinous compositions applied in step (a).

19. A process as claimed in any of claims 4, 5 or 12 to 18 wherein prior to step (c) and additional overall transparent layer is applied as a wear layer.

20. A process as claimed in claim 19 wherein the additional layer is provided by a polyvinyl chloride composition.

21. A process as claimed in claim 19 or claim 20 wherein the additional layer has a thickness of from 0.004 to 0.015 inches.

22. A process as claimed in any of claims 4, 5 and 12 to 21 wherein step (c) the heating is effected at a temperature of from 165 to 200°C.

23. A process as claimed in any of claims 1 to 3 and 6 to 11 wherein the foamable resinous composition(s) is/are as defined in any of claims 12 to 14.

24. A process as claimed in any of claims 1 to 3, 6 to 11 and 23 wherein in step (a) the foamable resinous composition(s) is/are applied as defined in claim 15.

25. A process as claimed in any of claims 1 to 3, 6 to 11, 23 and 24 wherein in step (b) the overall layer of resinous composition is provided as defined in claim 16 or claim 17.

26. A process as claimed in any of claims 1 to 3, 6 to 11 and 23 to 25 wherein prior to step (c) an additional layer as defined in any of claims 19 to 21 is applied as a wear layer.

27. A process as claimed in any of claims 1 to 3, 6 to 11 and 23 to 26 wherein in step (c) the heating is effected as defined in claim 22.

28. A process as claimed in any of the preceding claims wherein in step (a) a thickness of from 0.002 to 0.005 inches of foamable resinous composition(s) is applied.

29. A process as claimed in any of the preceding claims wherein in step (b) the overall layer of resinous composition is applied to give a thickness of the overall layer, measured at points where selected areas of a foamable composition have been applied in step (a), of at least 0.005 inches.

30. A process for the production of a surface covering material having a textured effect substantially as herein described with reference to Figs. 1 to 5 of the accompanying drawings.

31. A process for the production of a surface covering material having a textured effect substantially as herein described with reference to Figs. 6 to 11 of the accompanying drawings.

32. A process for the production of a surface covering material having a textured effect substantially as herein described in Example 1.

33. A process for the production of a surface covering material having a textured effect substantially as herein described in Example 2 or Example 3.

34. A surface covering material having a textured effect when produced by a process as claimed in any of claims 4, 5, 12 to 22 and 30 to 32.

35. A surface covering material having a textured effect when produced by a process as claimed in any of claims 1 to 3, 6 to 11, 23 to 29 and 33.

36. A surface covering material having a textured effect which comprises a substate, foamed resinous composition(s) on selected area of the substrate, at least one layer of an essentially non-foamed resinous composition over the substrate and the foamable resin composition(s) thereon; and a decorative pattern printed on the surface of the overall layer(s).

37. A surface covering material as claimed

in claim 36 wherein the overall layer or uppermost overall layer is pigmented.

38. A surface covering material as claimed in claim 36 or 37 wherein the substrate comprises a non-woven or woven fabric.

39. A surface covering material as claimed in any of claims 36 to 38 which includes an overall transparent wear layer over the decorative pattern.

40. A surface covering material as claimed in any of claims 36 to 39 wherein the resinous compositions are provided by polyvinyl chloride resinous compositions.

41. A surface covering material as claimed in any of claims 36 to 40 wherein the substrate includes a layer of foamed resinous composition.

42. A surface covering material as claimed in claim 41 wherein the foamed resin composition(s) on selected areas of the substrate is/are in direct contact with the said layer of foamed resin composition.

43. A surface covering material having a textured effect which comprises a substrate, foamed resinous composition(s) on selected areas of the substrate and at least one layer of an essentially non-foamed resinous composition over the substrate and the foamable resin composition(s) thereon: the surface of the substrate and/or the foamed resinous composition(s) being pigmented and the overall layer(s) being transparent or translucent, when prepared by a process as claimed in any of claims 1 to 3; 6 to 11 and 22 to 28.

44. A surface covering material as claimed in claim 43 having the further features set out in any of claims 37, 38 and 40 to 42.

45. A surface covering material having a textured effect as claimed in claim 36 or claim 43 and substantially as herein described.

46. A surface covering material having a textured effect substantially as herein described with reference to Fig. 5 of the accompanying drawings.

47. A surface covering material having a textured effect substantially as herein described with reference to Fig. 11 of the accompanying drawings.

For the Applicants,
FRANK B. DEHN & CO.,
Imperial House,
15—19, Kingsway,
London, WC2B 6UZ.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1975.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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FIG.1.

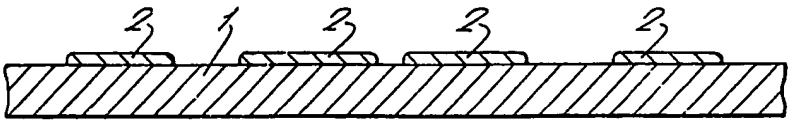


FIG.2.

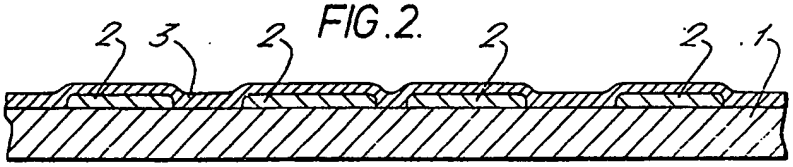


FIG.3.

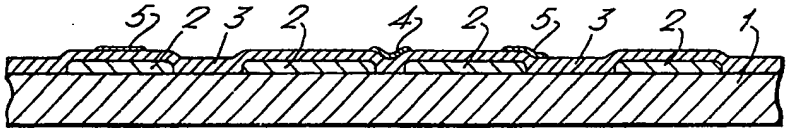


FIG.4.

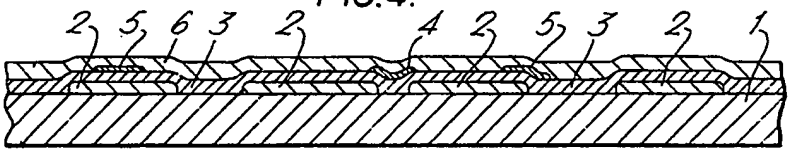


FIG.5.

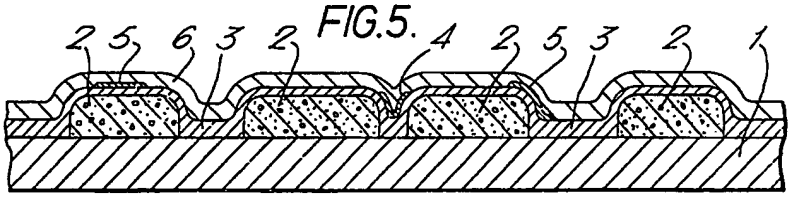
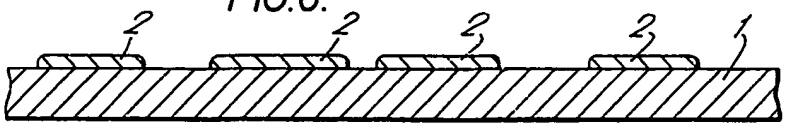


FIG.6.



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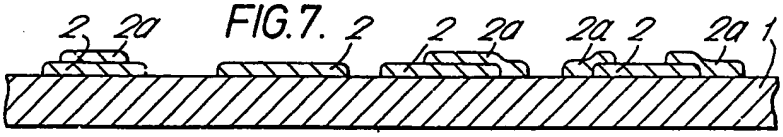


FIG.8.

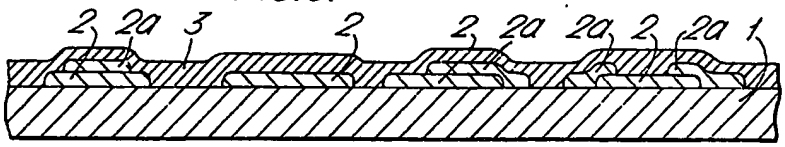


FIG.9.

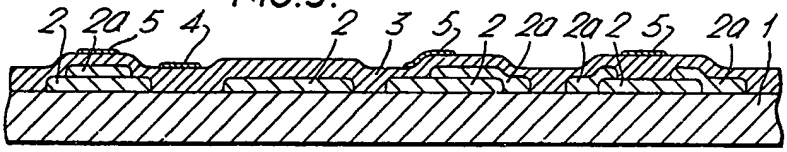


FIG.10.

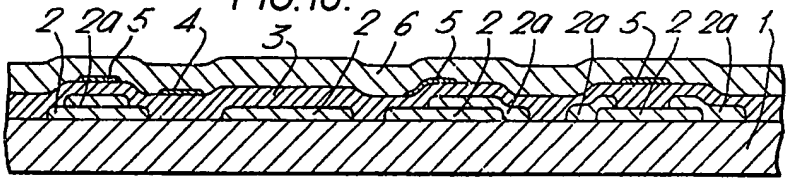
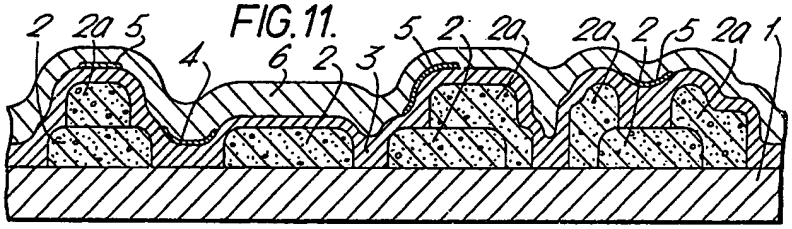


FIG.11.



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